Platelets lysate-based membranes for periodontal ligament regeneration

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The periodontal ligament (PDL) is a group of specialized connective tissue fibers that attach a tooth to the alveolar bone where it is deployed. These fibers help the tooth withstand the substantial compressive forces which occur during chewing and remain embedded in the bone. Periodontitis is a prevalent infection disease that causes the destruction of the tooth supportive tissues including the PDL. Given its low ability of regeneration in adult patients, concerted efforts have been made to accelerate periodontal tissue regeneration. Nevertheless, a strategy for predictable reconstruction of normal structure and functionality of periodontal damaged tissue is yet to be achieved. In this work, we present a novel membrane based on platelets lysate (PL) aiming for PDL regeneration.

PL is a source of multiple growth factors (GFs) such as PDGF-BB, VEGF, and TGF-β1, which are prompt to induce wound healing and the recruitment of cells for tissue regeneration. In this work, we propose the development of PL-based membranes prepared by crosslinking PL proteins with genipin for periodontal tissue regeneration.

Increasing concentrations of genipin (0.10, 0.18 and 0.25 % w/v) were used to crosslink PL proteins to produce PL-based membranes. The resulting membranes showed increasing crosslinking density proportional to the crosslinker concentration. In addition, the morphological and mechanical features have shown to be dependent on the crosslinking degree of the PL membranes.

The release of specific GFs was quantified by ELISA. Results show that the produced membranes are able to release the GFs contained in PL in a controlled manner and proportional to the crosslinking density, with a higher cumulative release for the samples with lower crosslinking density.

In vitro assays were performed both using human adipose derived stem cells (hASCs) and periodontal ligament fibroblasts (hPDLFs). While no significant proliferation was detected when using hASCs, the hPDLFs showed good adhesion and proliferation on the membranes, suggesting its compatibility with PDL regeneration approaches.

The PL-based membranes developed in this work, present high stiffness and elasticity and, consequently, a great potential in the regeneration of elastic and mechanically active tissues. Moreover these membranes have demonstrated to act as a valuable substrate for hPDLFs attachment and growth in 2D conditions and provide an environment rich in GFs with a major role in wound healing. These results suggest that it is possible to produce stable PL-based membranes crosslinked with genipin and that these membranes have great potential for future applications in the regeneration of PDL.